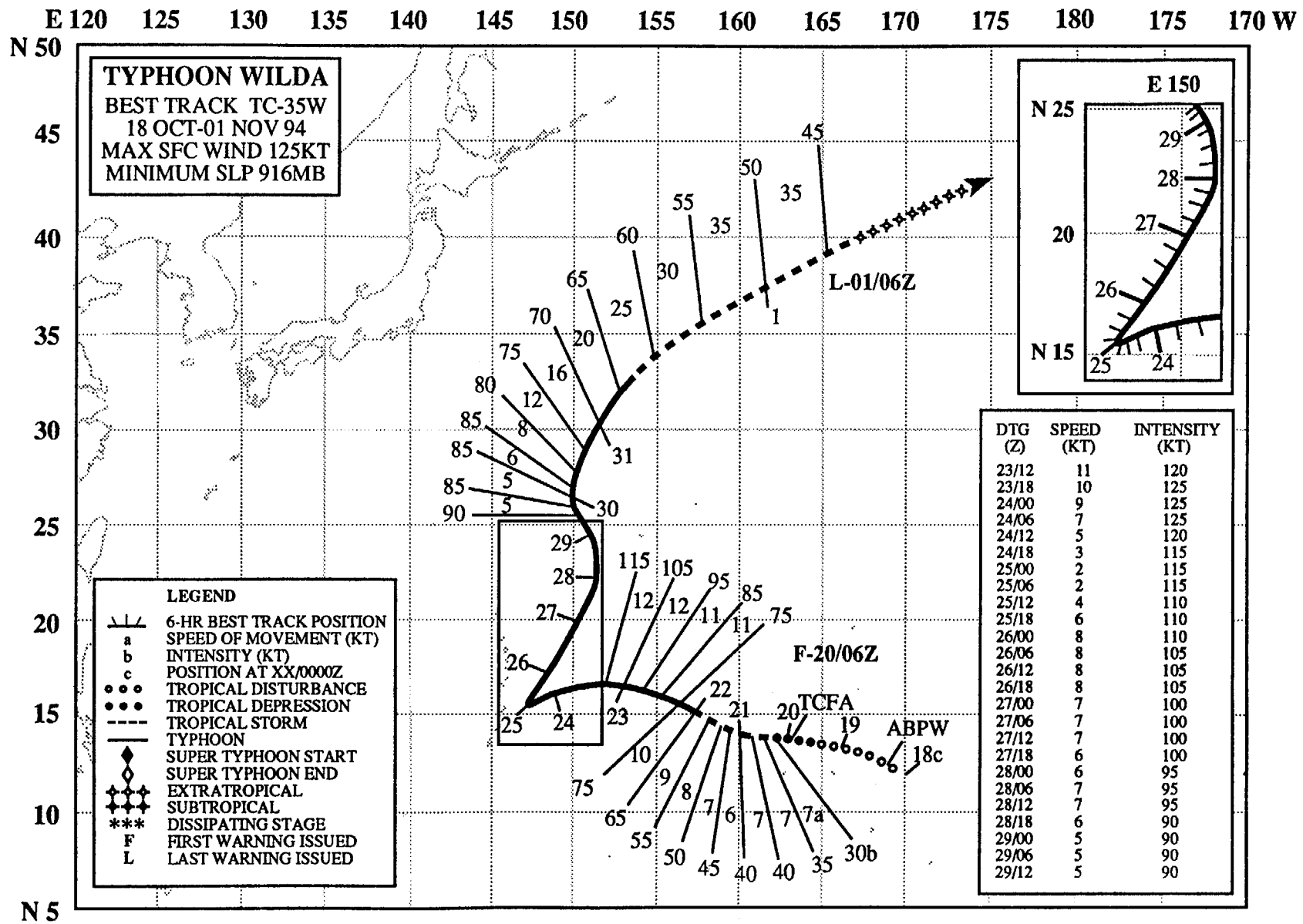

DTG (Z)	SPEED (KT)	INTENSITY (KT)
23/12	11	120
23/18	10	125
24/00	9	125
24/06	7	125
24/12	5	120
24/18	3	115
25/00	2	115
25/06	2	115
25/12	4	110
25/18	6	110
26/00	8	110
26/06	8	105
26/12	8	105
26/18	8	105
27/00	7	100
27/06	7	100
27/12	7	100
27/18	6	100
28/00	6	95
28/06	7	95
28/12	7	95
28/18	6	90
29/00	5	90
29/06	5	90
29/12	5	90

TYPHOON WILDA (35W)

I. HIGHLIGHTS

The third tropical cyclone of a mid-October four-storm outbreak, Wilda exhibited unusual motion. Wilda intensified to a peak of 125 kt (64 m/sec) during a quasi-stationary period near 15.6N ; 147.2E. During the stall, the monsoon trough within which Wilda was embedded acquired a reverse orientation. Coming out of the stall, Wilda moved on a slow north-oriented "S"-track.

II. TRACK AND INTENSITY

By mid-October, an active monsoon trough extended across the Philippine Sea (at 15°N), and from there, east-southeastward to a terminus in the Marshall Islands. At 180600Z, there were two named tropical cyclones — Teresa (34W) and Verne (33W) — and a tropical disturbance located along this trough axis. This tropical disturbance, which later became Wilda, was was first mentioned on the 180600Z October Significant Tropical Weather Advisory when it was located near 10°N; 170°E at the eastern terminus of the monsoon trough. At 192230Z a Tropical Cyclone Formation Alert was issued based on increased central deep convection and a well-organized cirrus outflow pattern. At 200600Z the first warning was issued based upon persistence of the central deep convection and a rapid improvement in the organization of the central and peripheral deep convection. At 201800Z, Tropical Depression 35W was upgraded to Tropical Storm Wilda, and at 220000Z, Wilda was upgraded to a typhoon. Post-analysis of satellite and synoptic data indicated that Wilda most probably became a 25 kt (12 m/sec) tropical depression at 191200Z, and a tropical storm at 201200Z.

After becoming a typhoon, Wilda first moved west-northwestward, then westward along about 16.7°N, and then west-southwestward, threatening Saipan. At approximately 241200Z, Wilda abruptly slowed and remained quasi-stationary for 24 hours at a position about 90 nm (170 km) ENE of Saipan and 180 nm (330 km) NE of Guam (Figure 3-35-1). Wilda's intensity peaked at 125 kt (64 m/sec) at 231800Z, just as it began to turn west-southwestward towards Saipan. Later, during its one-day stall, it began to weaken slightly. At 251200Z, Wilda began to move toward the northeast on what would prove to be the first leg of a typical "S" track (Lander 1995a). While moving northeastward, Wilda weakened from 115 kt to 95 kt. After 280600Z, Wilda turned toward the north-northwest and weakened further. After 291800Z, Wilda turned northeastward (on the last leg of its "S" track) and accelerated. At 010600Z November, the final warning was issued as Wilda tracked northeastward at 35 kt (65 km/hr), and its cloud signature indicated that a transition to an extra-tropical cyclone had occurred.

III. DISCUSSION

a. NEXRAD's view of Wilda

When Wilda stalled northeast of Guam, it was at its closest point of approach of 180 nm (330 km). Although poorly defined, Wilda's eye was discernible on the NEXRAD reflectivity product for a short time. The poor eye definition was likely due to signal attenuation by heavy rainbands and a beam height of 20,000 ft at Wilda's 180 nm range. In contrast, Wilda's extensive peripheral cloud bands remained well-within radar range for several days.

For almost two days (240220Z to 260005Z), Guam's NEXRAD provided a continuous integration of the precipitation associated with Wilda. Estimated rainfall magnitudes and gradients were extreme (Figure 3-35-2). Over five inches fell in a narrow swath between Guam and Saipan. Within two small regions, covering an area of approximately 1400 square miles (roughly the land area of the state of

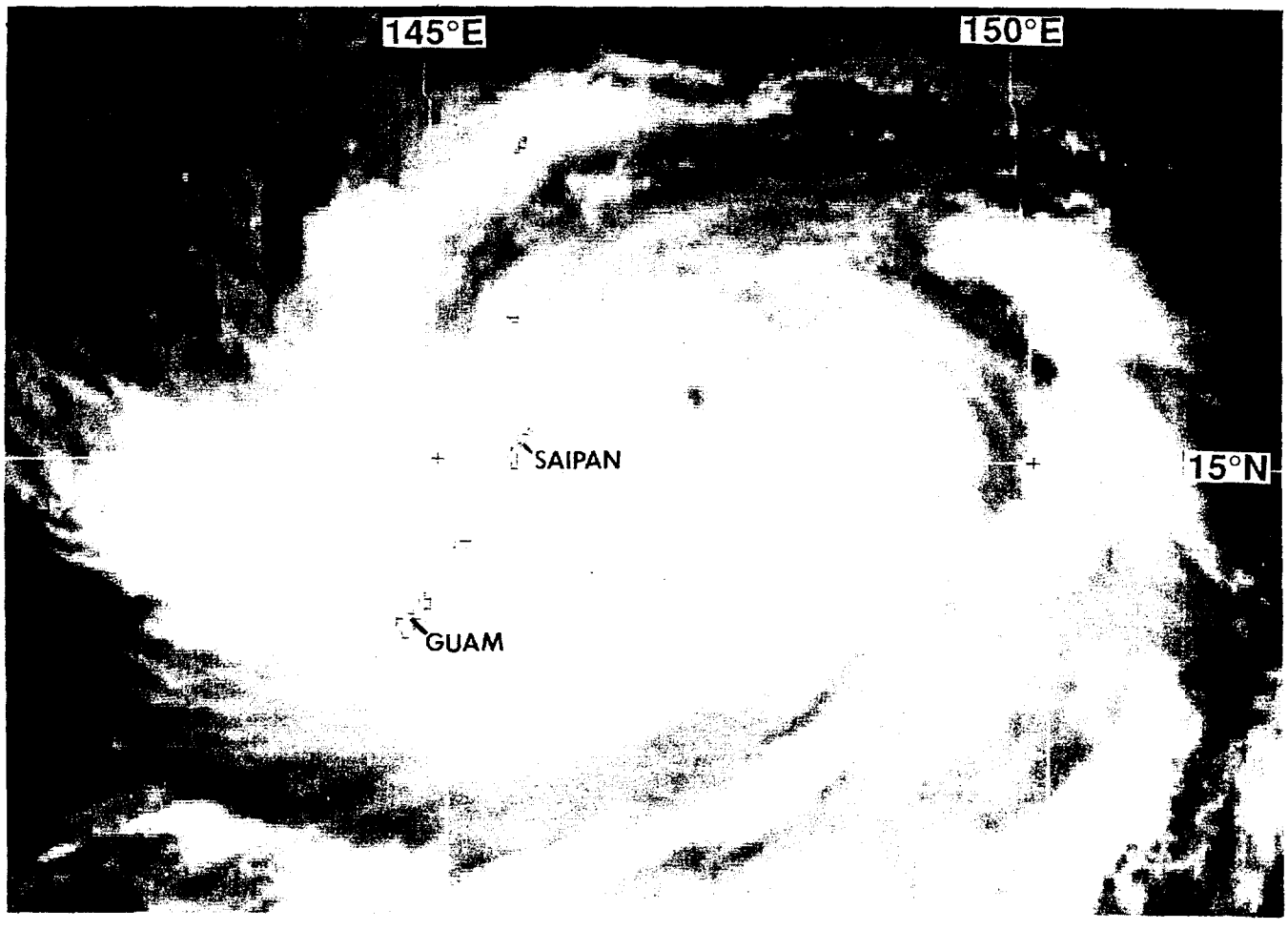

Figure 3-35-1 Wilda at an intensity of 115 kt (59 m/sec) has stalled about 90 nm (170 km) east-northeast of Saipan (242331Z October visible GMS imagery).

Rhode Island), over ten inches of rain was estimated to have fallen. On the island of Guam, the storm-total precipitation estimated by NEXRAD (Figure 3-35-3a) is about 20% short of the rainfall actually measured during Wilda's passage (Figure 3-35-3b). This was the most accurate storm-total precipitation estimated by NEXRAD on Guam to date. NEXRAD estimates are historically 25%-50% less than the measured values (for example, see Verne's (33W) summary). Its representation of the spatial distribution of rainfall (in this case, a narrow band of 3-4" inches of rain across the middle of the island with lighter amounts on the northern and southern ends of the island) was good.

b. Unusual motion

The monsoon trough which became active during mid-October was initially oriented WNW-ESE, and the tropical cyclones along its axis moved on west-northwesterly tracks consistent with climatology. Then, by virtue of the differential motions of Teresa (34W), Verne (33W), Wilda (35W), and Yuri (36W), the axis of the trough became oriented WSW-ENE (i.e., reverse oriented) at approximately 230000Z (see Figure 3-33-1c in Verne's summary). Concurrent with the monsoon trough's reverse orientation, Verne (33W) and Wilda stalled, and then moved on north-oriented tracks. After emerging from its one day stall, Wilda moved on an "S" shaped track (a track type which is almost exclusively associated with reverse orientation of the monsoon trough (Lander 1995a)).

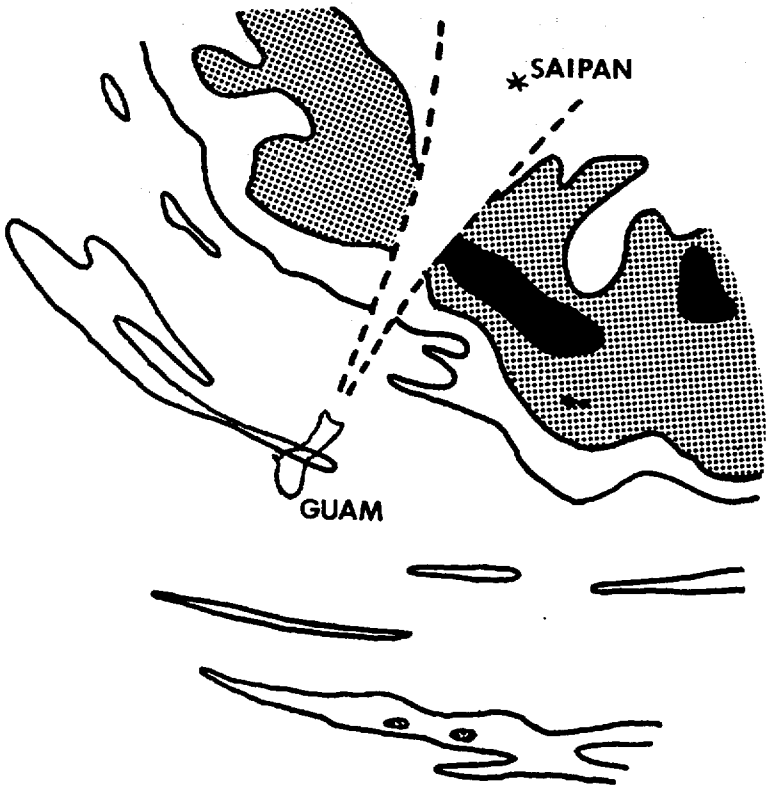

Figure 3-35-2 Estimated rainfall deposited by Wilda within 124 nm of Guam (NEXRAD storm-total precipitation for the period 240220Z to 252147Z October). Outer contour is three inches, half-tone indicates 5 to 10 inches, black-shaded area indicates 10 inches or more. The dashed lines enclose the area of radar beam blockage.

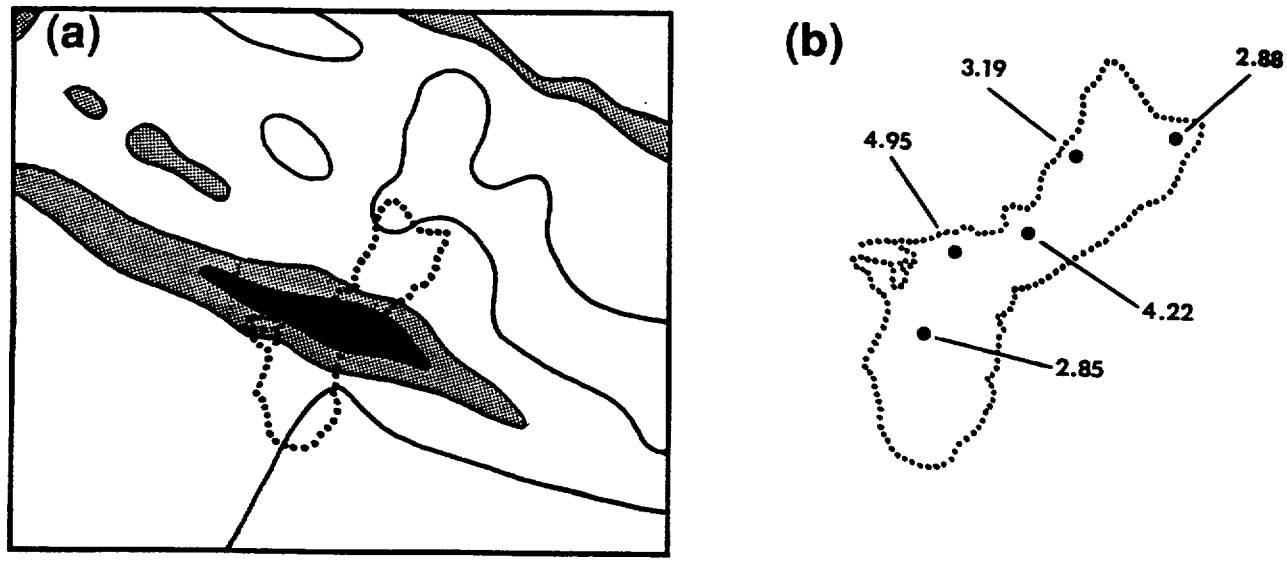

Figure 3-35-3 (a) Rainfall deposited on Guam by Wilda as estimated by NEXRAD during the period 240220Z to 252147Z October. Outer contour is 2 inches, half-tone indicates three to four inches, black-shaded area indicates four inches or more. (b) Rainfall measured on Guam during Wilda's passage.

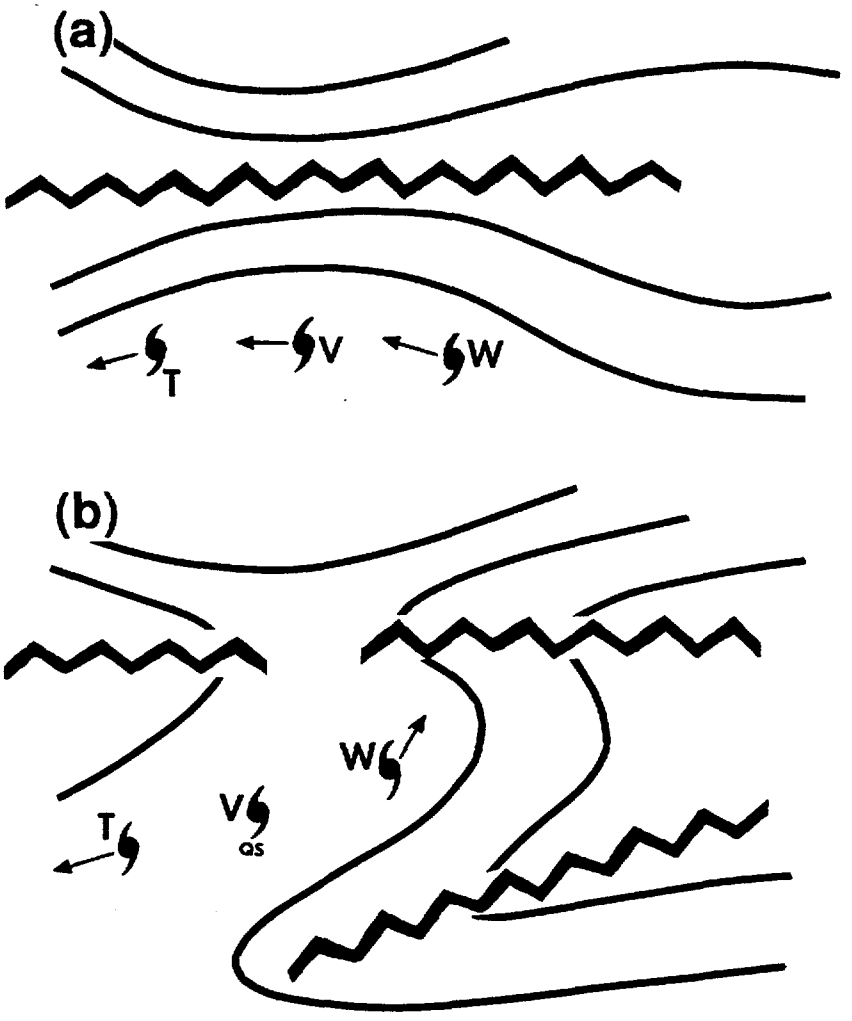

Figure 3-35-4 (a) Schematic illustration of the pattern of the 500 mb heights (adapted from NOGAPS analyses) in the western North Pacific while Teresa (T), Verne (V) and Wilda (W) moved westward. (b) Pattern of the 500 mb heights as the monsoon trough acquired a reverse orientation, and Wilda began to move northeastwards. Contours values are arbitrary. Zig-zag lines indicate ridge axes. Arrows depict motion of the tropical cyclones. QS = quasi-stationary.

The stall and the "S" track of Wilda were associated with an interesting evolution of the 500 mb pattern. At first, while Teresa (34W), Verne (33W), and Wilda were moving west-northwestward, the 500 mb height field featured a zonally oriented subtropical ridge (Figure 3-35-4a). As the monsoon trough acquired a reverse orientation, two ridge axes began to influence the motion of the tropical cyclones: one ridge axis was the preexisting subtropical ridge, and the other ridge axis developed to the southeast of the monsoon trough (Figure 3-35-4b). While Wilda was moving west-northwestward, the highest 500 mb heights were along the axis of the subtropical ridge. As Wilda stalled, pressure heights increased in the new ridge to the southeast. When pressure heights in the southeastern ridge exceeded the pressure heights along the subtropical ridge axis, Wilda began to move northeastward. The two-ridge structure at 500 mb (Figure 3-35-4b) remained in place as Wilda moved northward. The top half of Wilda's "S" motion occurred as Wilda moved through the subtropical ridge axis and entered the mid-latitude westerlies.

c. Air-sea interactions

As discussed in Verne's (33W) summary, tropical cyclones are known to cause cooling of the sea surface. This leads to the testable hypothesis that tropical cyclones which remain quasi-stationary over water for extended periods may weaken as the underlying sea surface temperature (SST) falls. Like

Verne (33W), Wilda provides a good test case.

While Wilda remained quasi-stationary for about 24 hours near 15.7°N ; 147.2°E, it weakened slightly from 125 kt (its peak intensity) to 115 kt. Later, coming out of its stall, it weakened slightly, but remained near 100 kt (51 m/sec) for the next three days. As was the case with Verne (33W), one can draw few conclusions from the case of Wilda about feedback of tropical cyclone induced SST changes upon the tropical cyclone itself (without rigorous study). At best, it can be shown that both Verne (33W) and Wilda induced some cooling of the SST (Figure 3-35-5).

d. Forecast performance

Despite unusual motion, the track forecasts errors for Wilda were lower than average, with mean errors at 24, 48, and 72 hours of 115, 193, and 223 nm respectively. Long-range (48 and 72-hour) track errors showed increases at three places along Wilda's track: (1) as it turned west-southwestward toward its stall position (forecasts then were for continued westward motion); (2) as it moved northeastward after the stall (forecasts then did not anticipate the magnitude of the bend back toward the north-northwest as Wilda executed the middle portion of its "S" track); and, (3) at the point of recurvature into the mid-latitude westerlies (the timing of the acceleration to the northeast was a problem).

Intensity forecasts were quite poor at two times: (1) in the early stages, the intensity was significantly under-forecast by as much as 35 kt at 24 hours, 45 kt at 48 hours and 50 kt at 72 hours ; and, (2) upon coming out of its stall and moving northeastward, the rate of weakening was over-forecast. Real-time diagnosis of intensity was 25 kt low (with respect to the final best-track intensity estimates) as Wilda reached its peak intensity; up to 20 kt too high during Wilda's stall; and then within 5 kt of the final best-track intensity as Wilda executed the "S" portion of its track.

IV. IMPACT

Wilda brought gusty winds, hazardous surf, and heavy rain to Guam, Rota, Tinian and Saipan. The highest recorded wind gust recorded on Guam was 74 kt (38 m/sec) at the JTWC. On Saipan, high winds downed trees and power lines, and pulled tin roofs from houses. Eleven people were injured in typhoon-related accidents. At the Saipan port, two tugboats sank, a flat barge was lost, and 50 welding machine units were destroyed. Offshore, the Philippine-registered ship, *M/V Ronda*, nearly sank in 30 to 40 foot high seas. On Guam, three surfers were missing and presumed drowned in rough seas off the northern end of the island. A surfboard and two boogie boards washed ashore, but the surfers were never found.

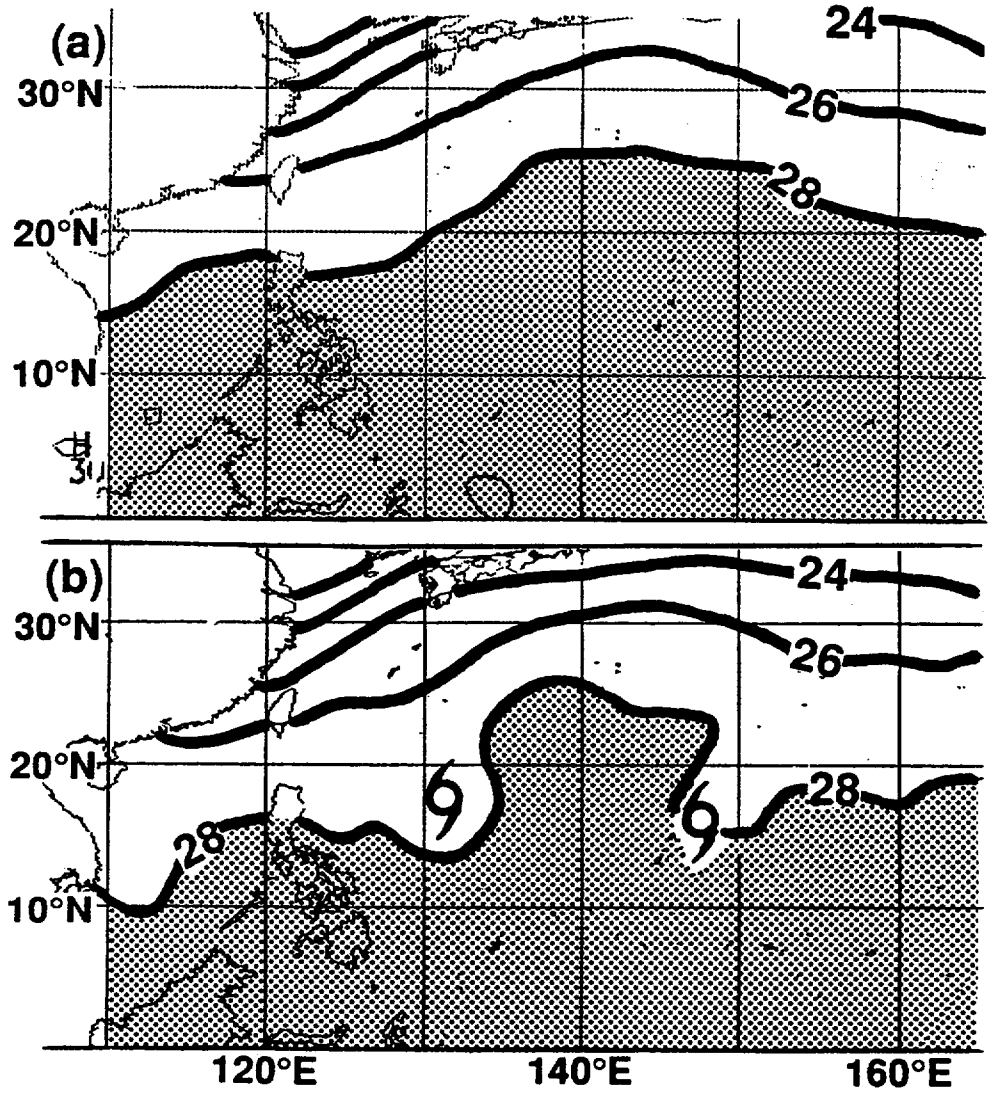

Figure 3-35-5 (a) SST analysis at 211200Z October. (b) SST analysis at 271200Z October. Notice the cooling of the SST at the stall locations of Verne (33W) and Wilda.